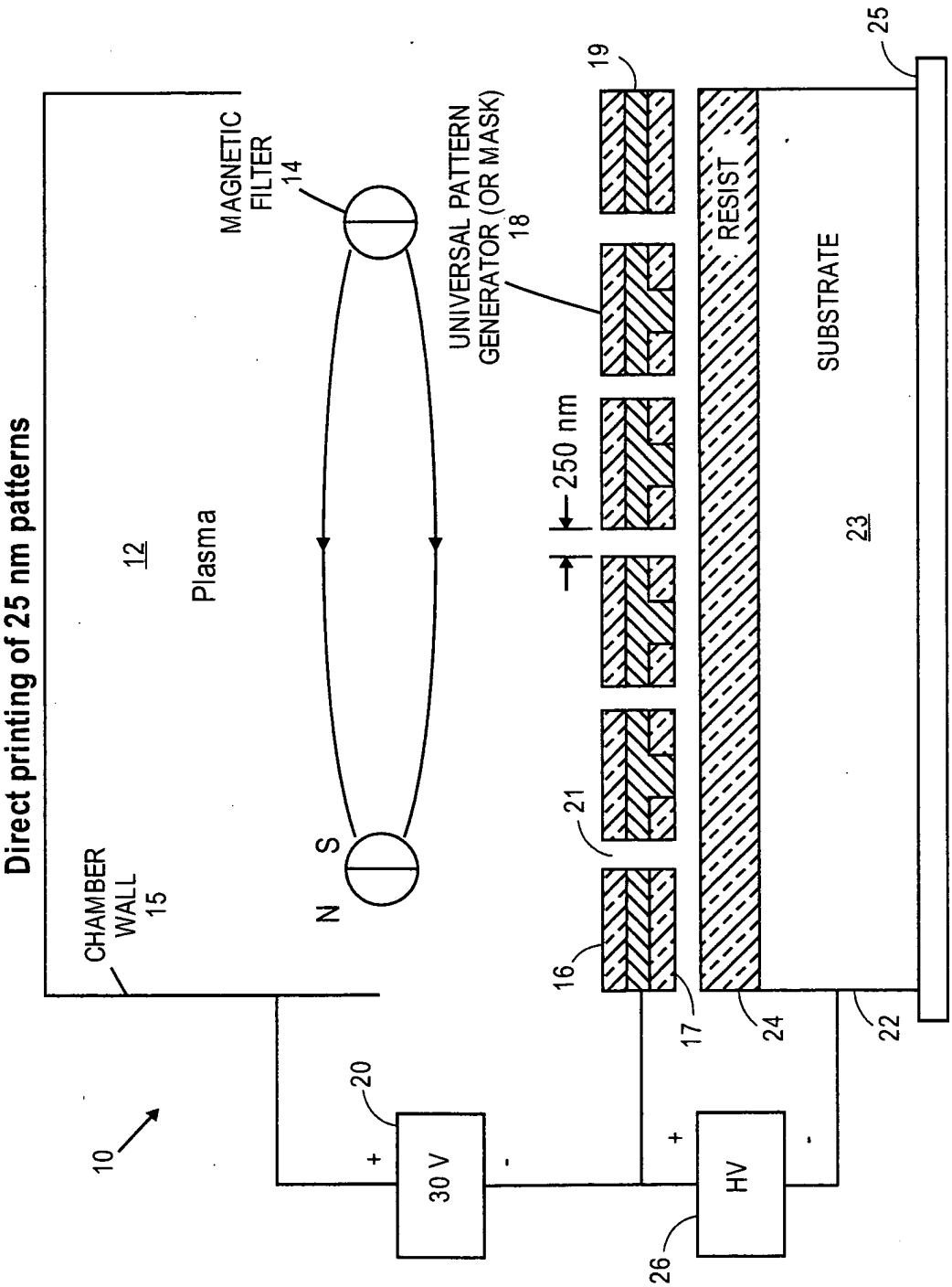
FIG. 1



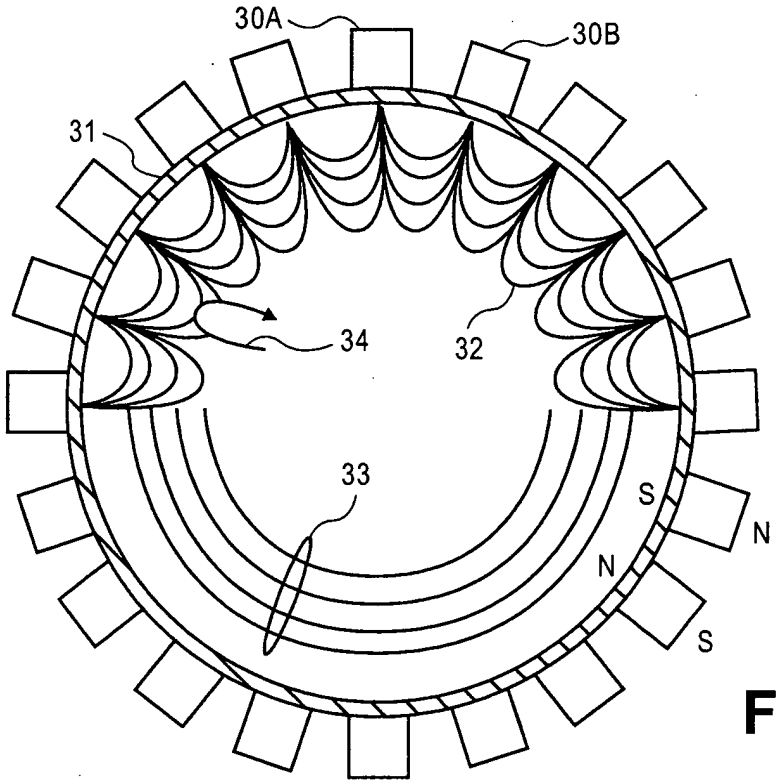

30A
30B
31
34
32
33
S
N
N
S

FIG. 2A

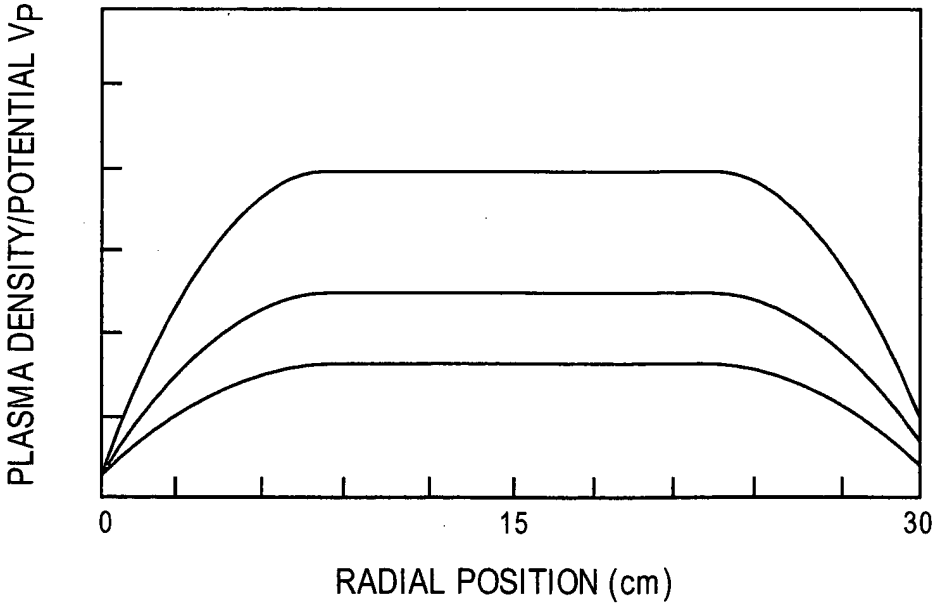

PLASMA DENSITY/POTENTIAL Vp
0
15
30
RADIAL POSITION (cm)

FIG. 2B

FIG. 3

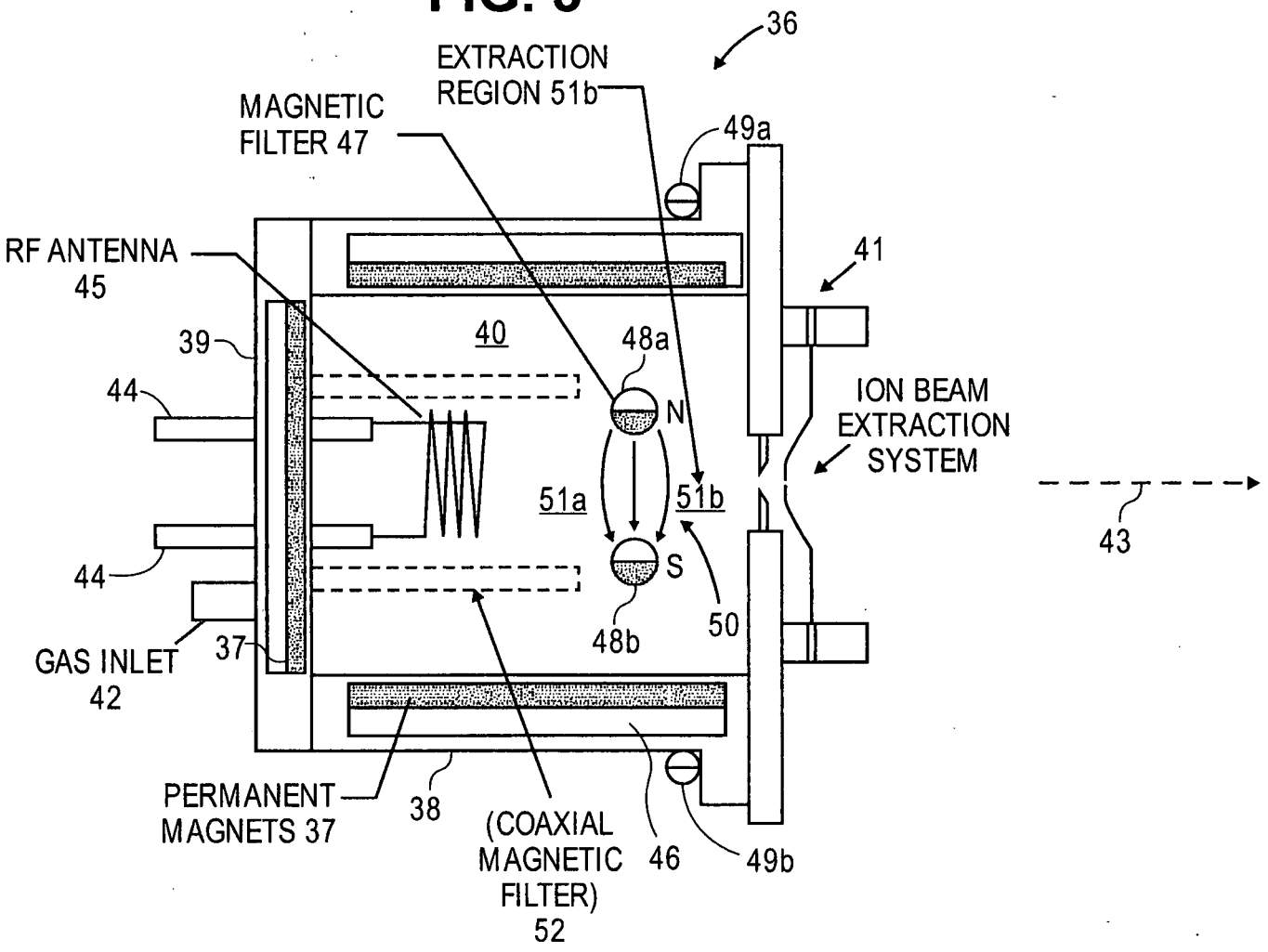

36
EXTRACTION REGION 51b
MAGNETIC FILTER 47
49a
RF ANTENNA 45
41
39
40
48a
44
N
ION BEAM EXTRACTION SYSTEM
51a
51b
44
S
43
48b
50
GAS INLET 42
37
PERMANENT MAGNETS 37
38
(COAXIAL MAGNETIC FILTER) 52
46
49b

FIG. 4

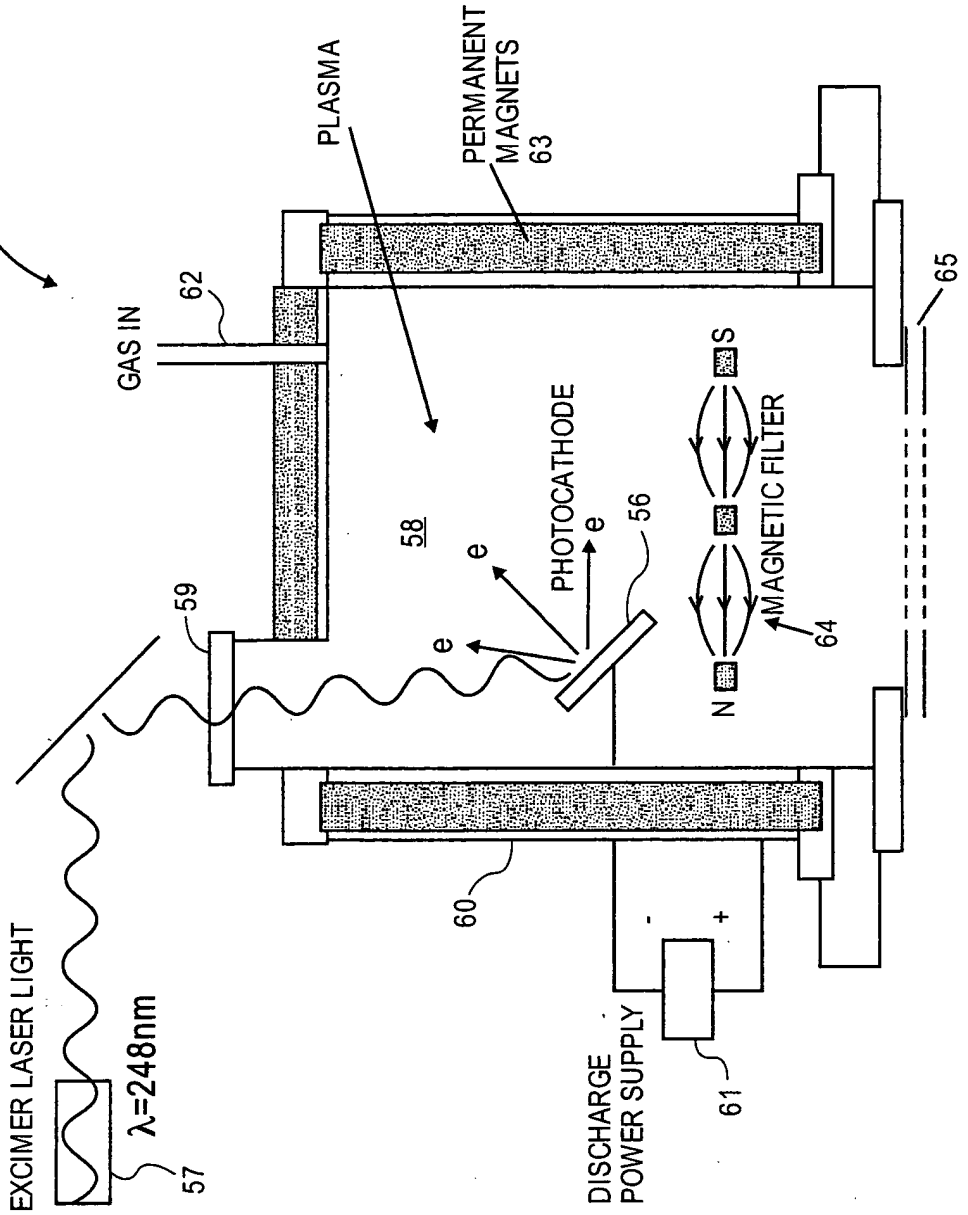

55
EXCIMER LASER LIGHT
λ=248nm
57
59
GAS IN
62
PLASMA
PERMANENT MAGNETS
63
58
e
e
PHOTOCATHODE
e
56
S
N
MAGNETIC FILTER
64
65
60
DISCHARGE POWER SUPPLY
-
+
61

FIG. 5

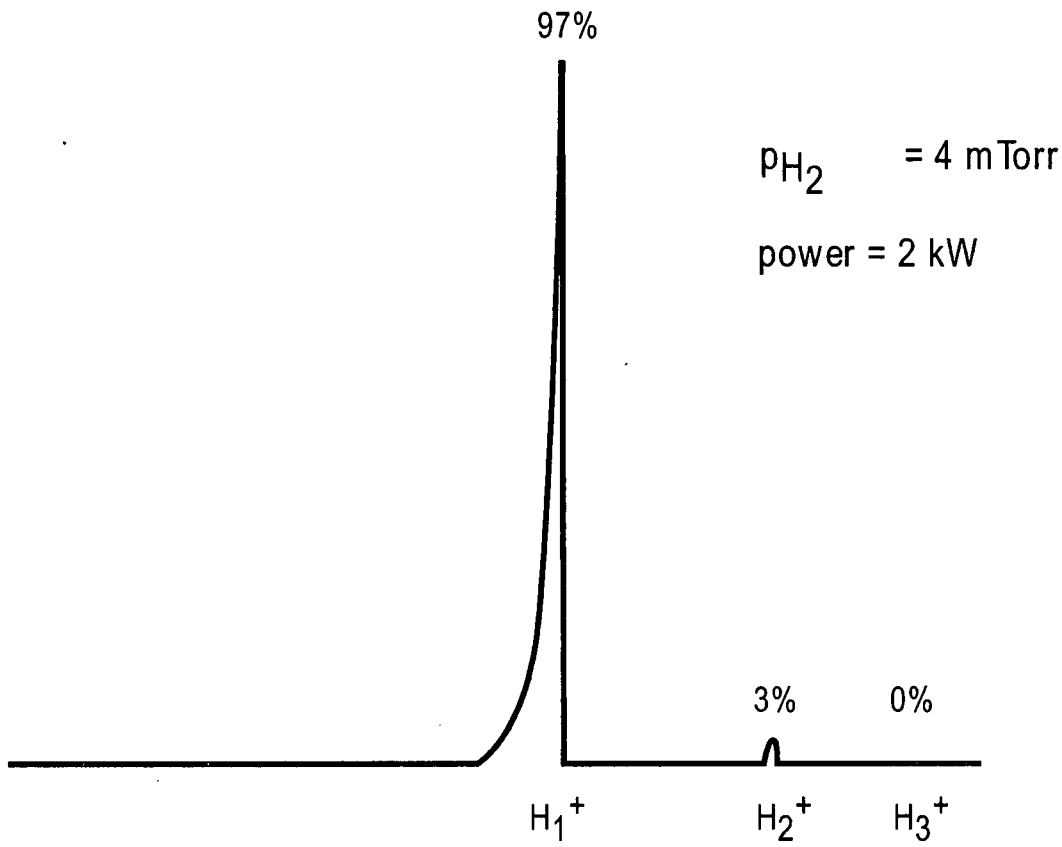


FIG. 6A

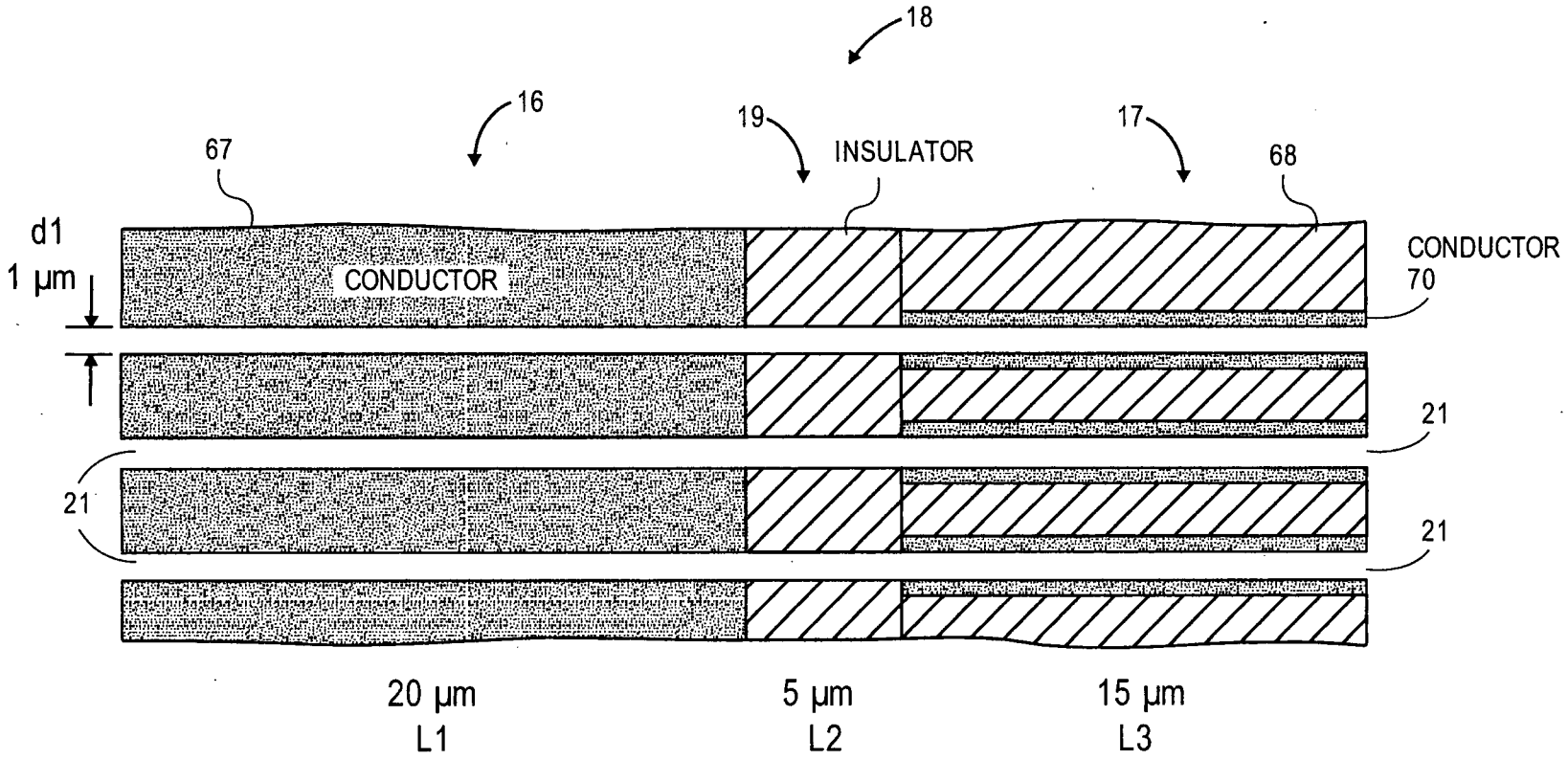

18
16
19
17
67
INSULATOR
68
d1
1 µm
CONDUCTOR
CONDUCTOR
70
21
21
21
20 µm
L1
5 µm
L2
15 µm
L3

FIG. 6B

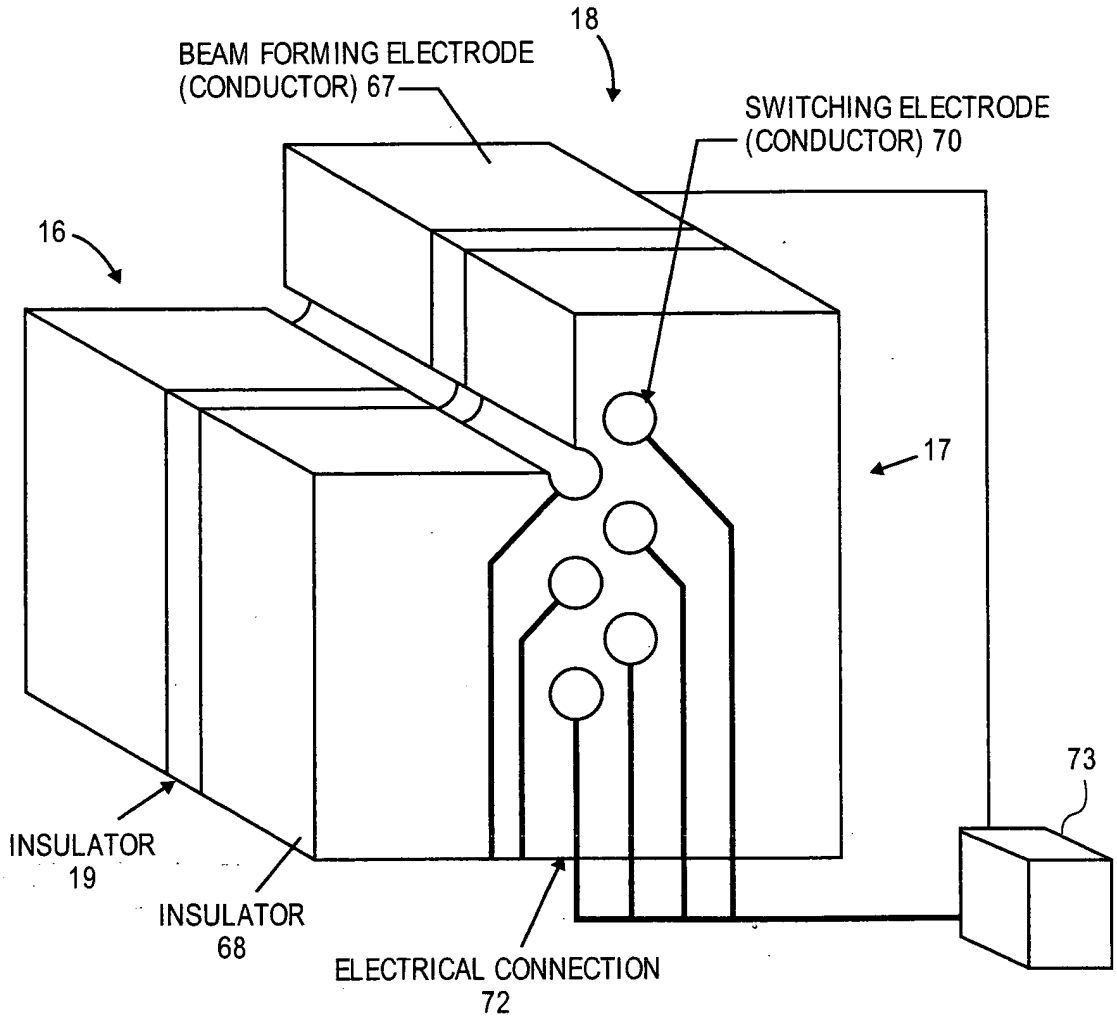

18
BEAM FORMING ELECTRODE
(CONDUCTOR) 67
SWITCHING ELECTRODE
(CONDUCTOR) 70
16
17
73
INSULATOR
19
INSULATOR
68
ELECTRICAL CONNECTION
72

FIG. 6C

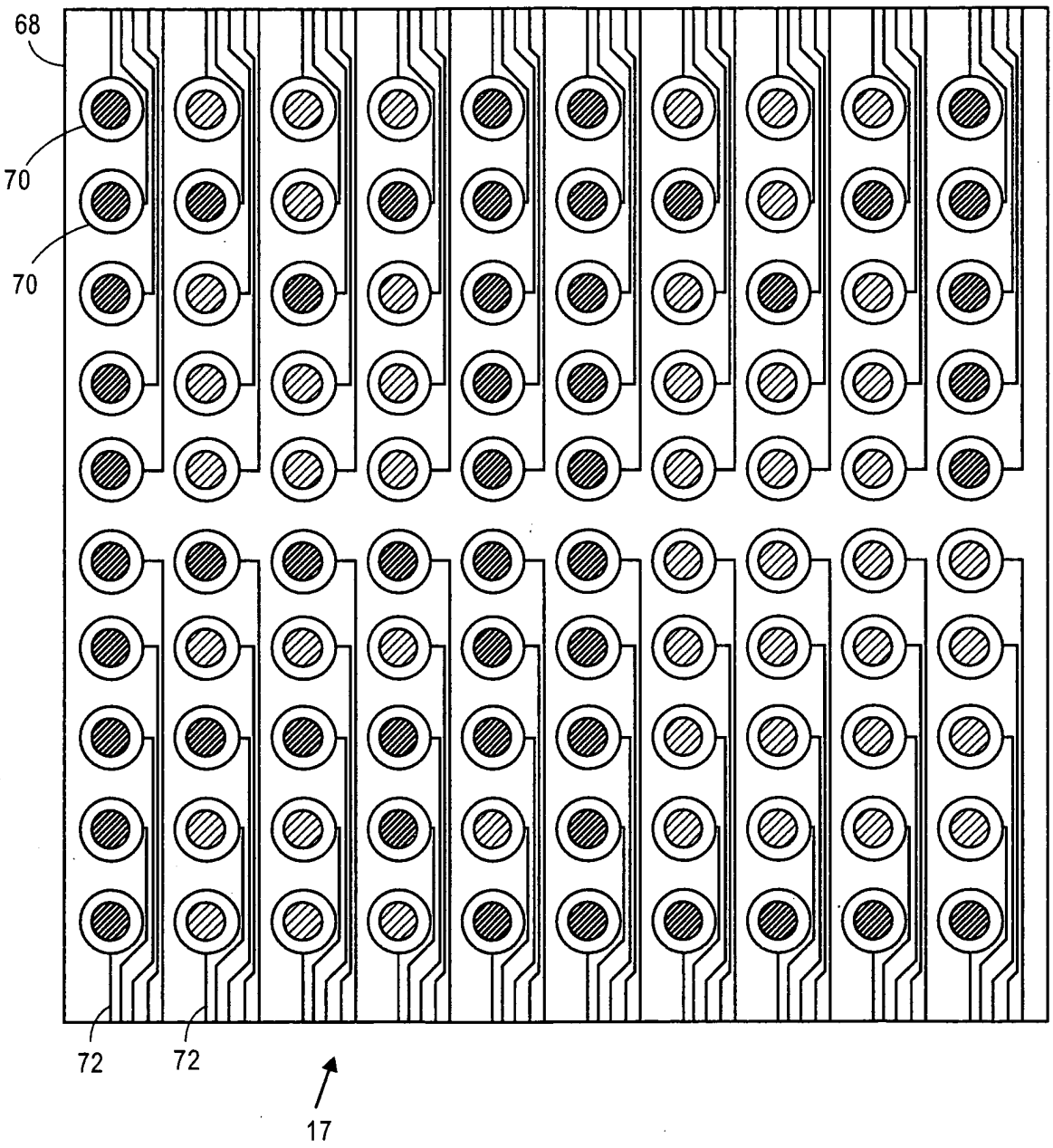


FIG. 6D

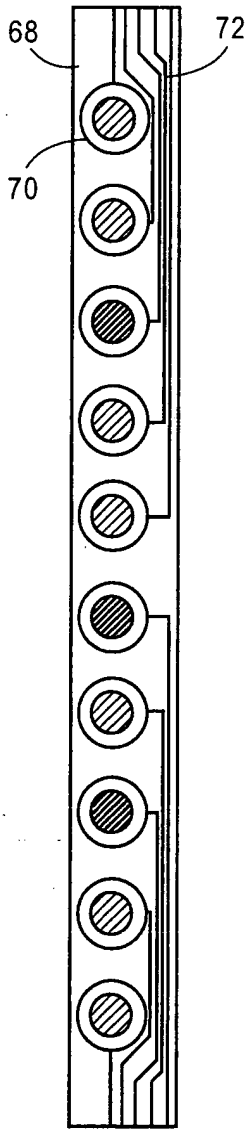


FIG. 6E

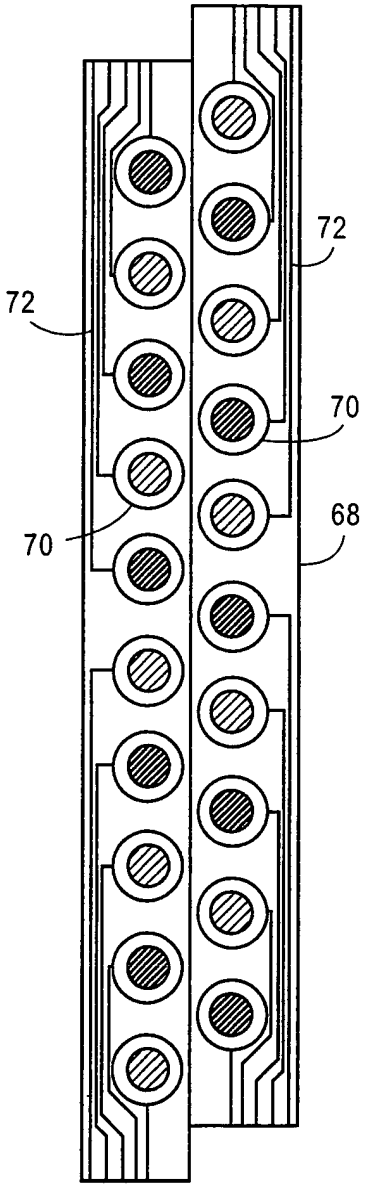


FIG. 7

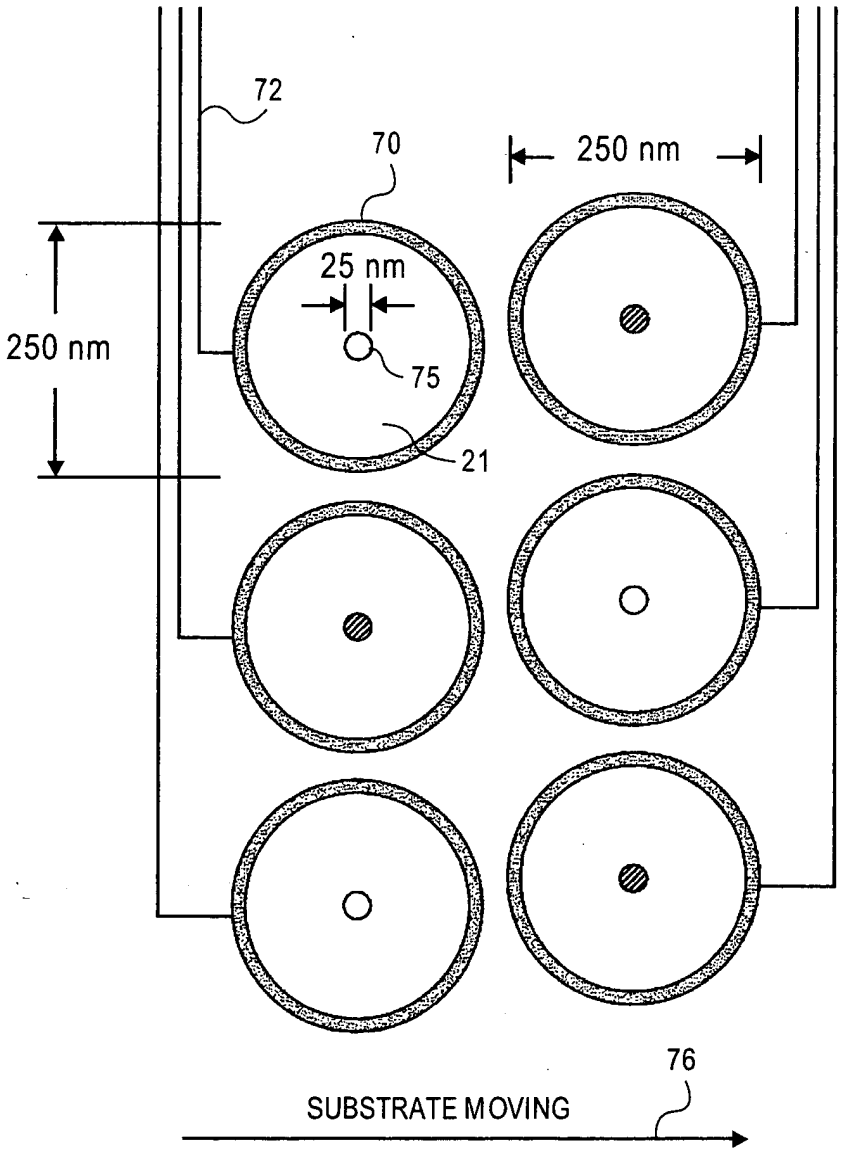


FIG. 8

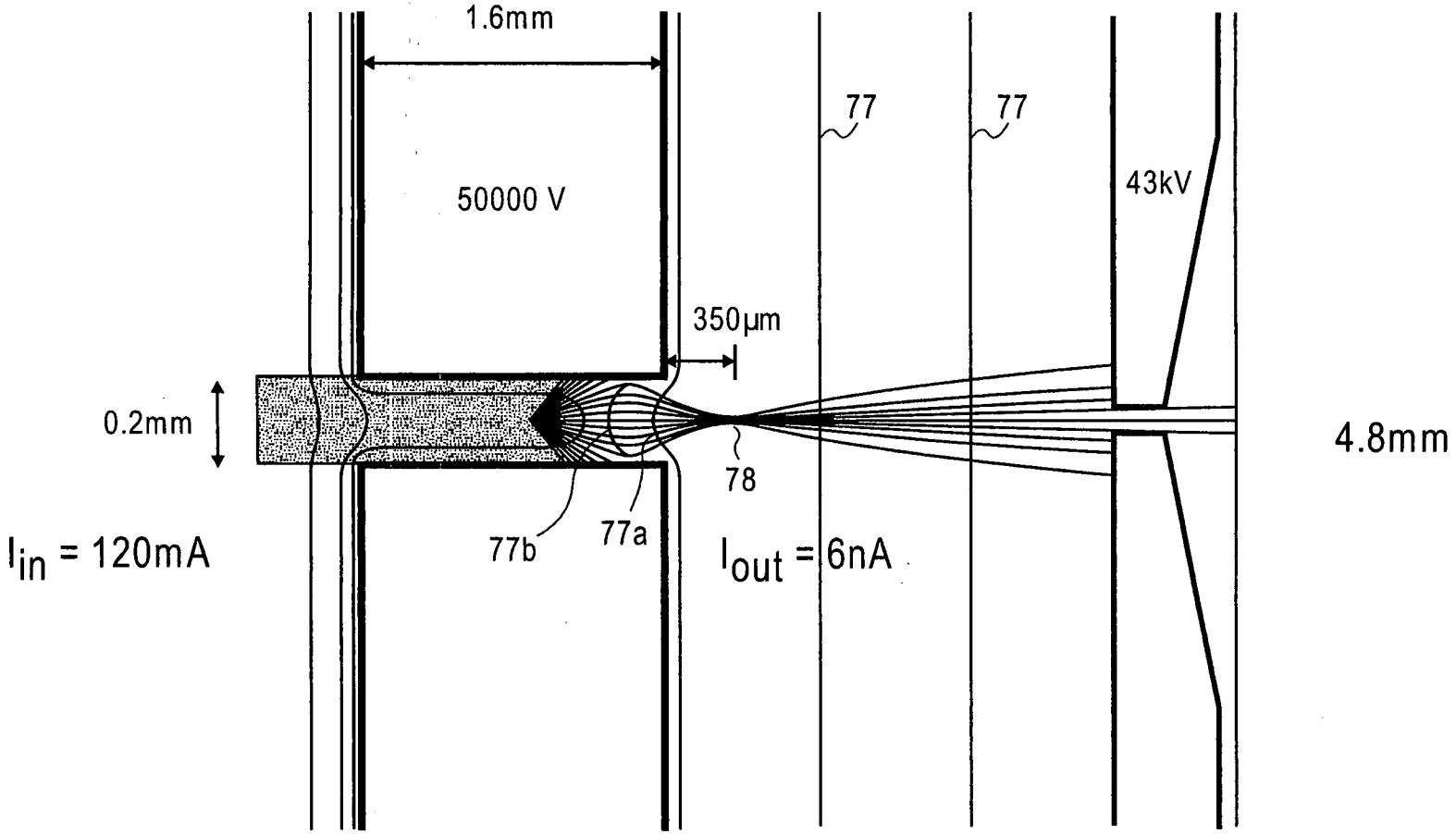

1.6mm
50000 V
77
77
43kV
350µm
0.2mm
4.8mm
78
77b
77a
I_{in} = 120mA
I_{out} = 6nA

FIG. 9

Beamlet Extraction from Pattern Generator

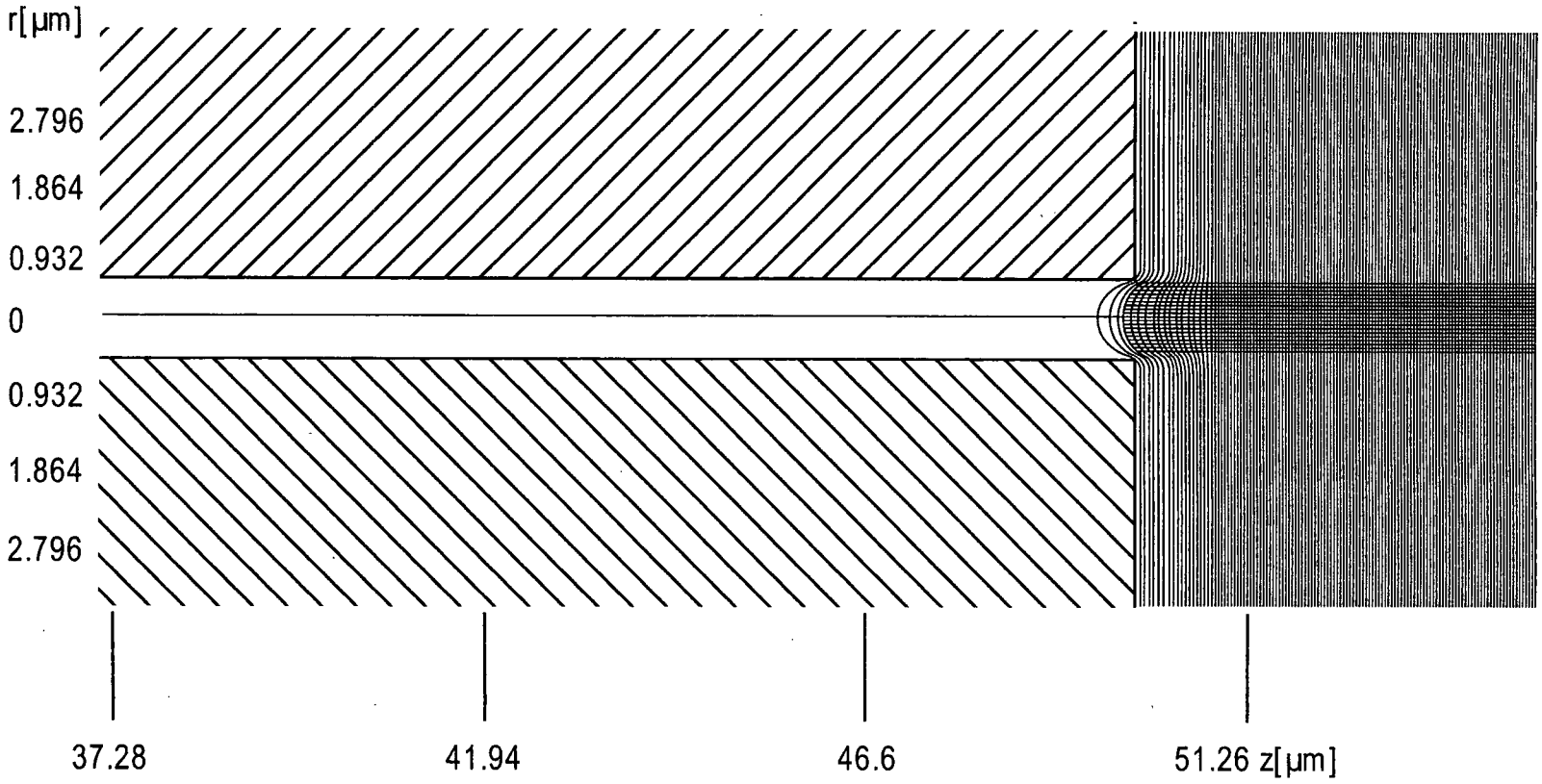


FIG. 10

Beam Extraction E=300 kV/cm, Ø=1μm

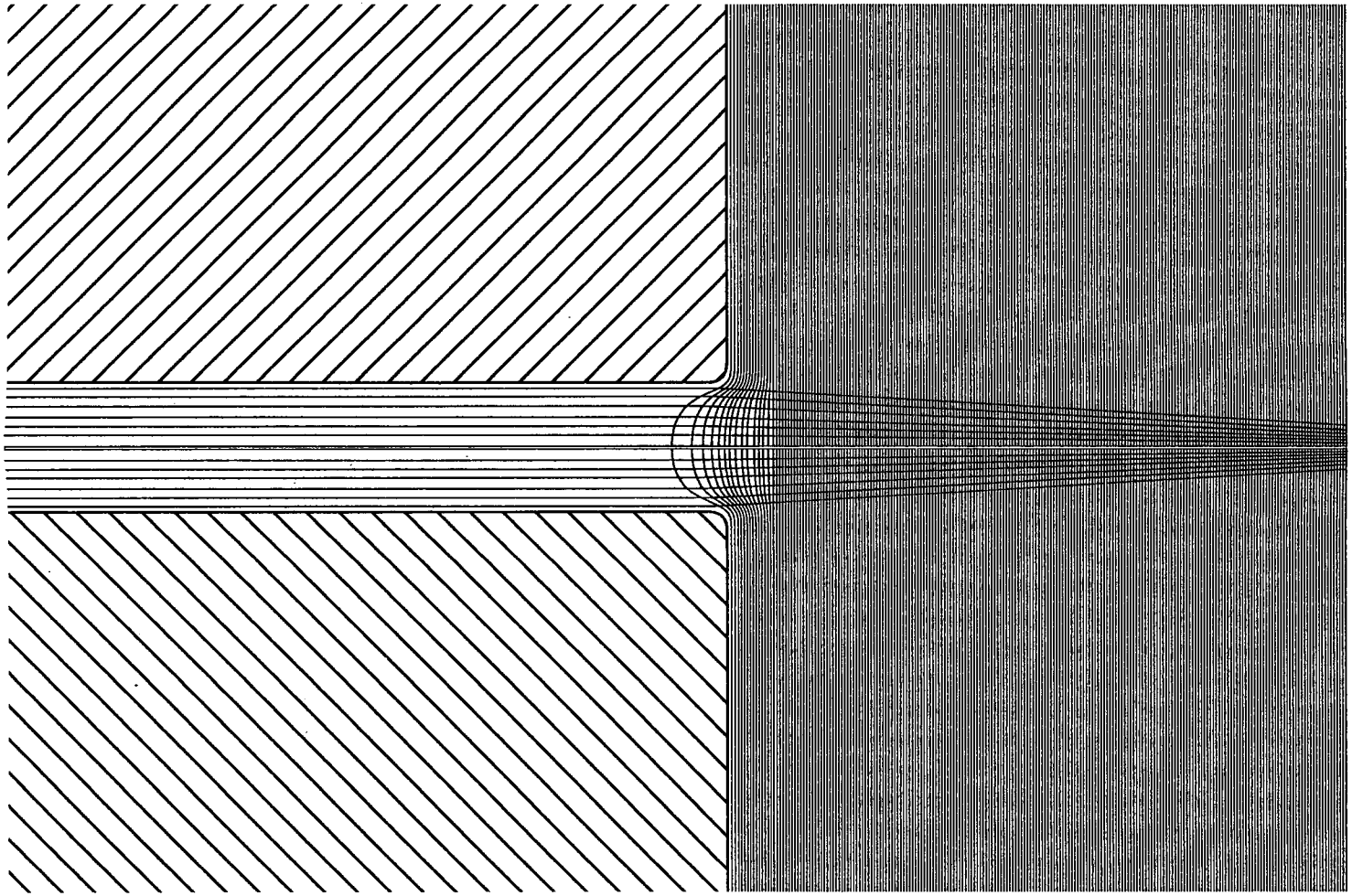


FIG. 11

Beam Extraction E=27.5 kV/cm, Ø=1μm

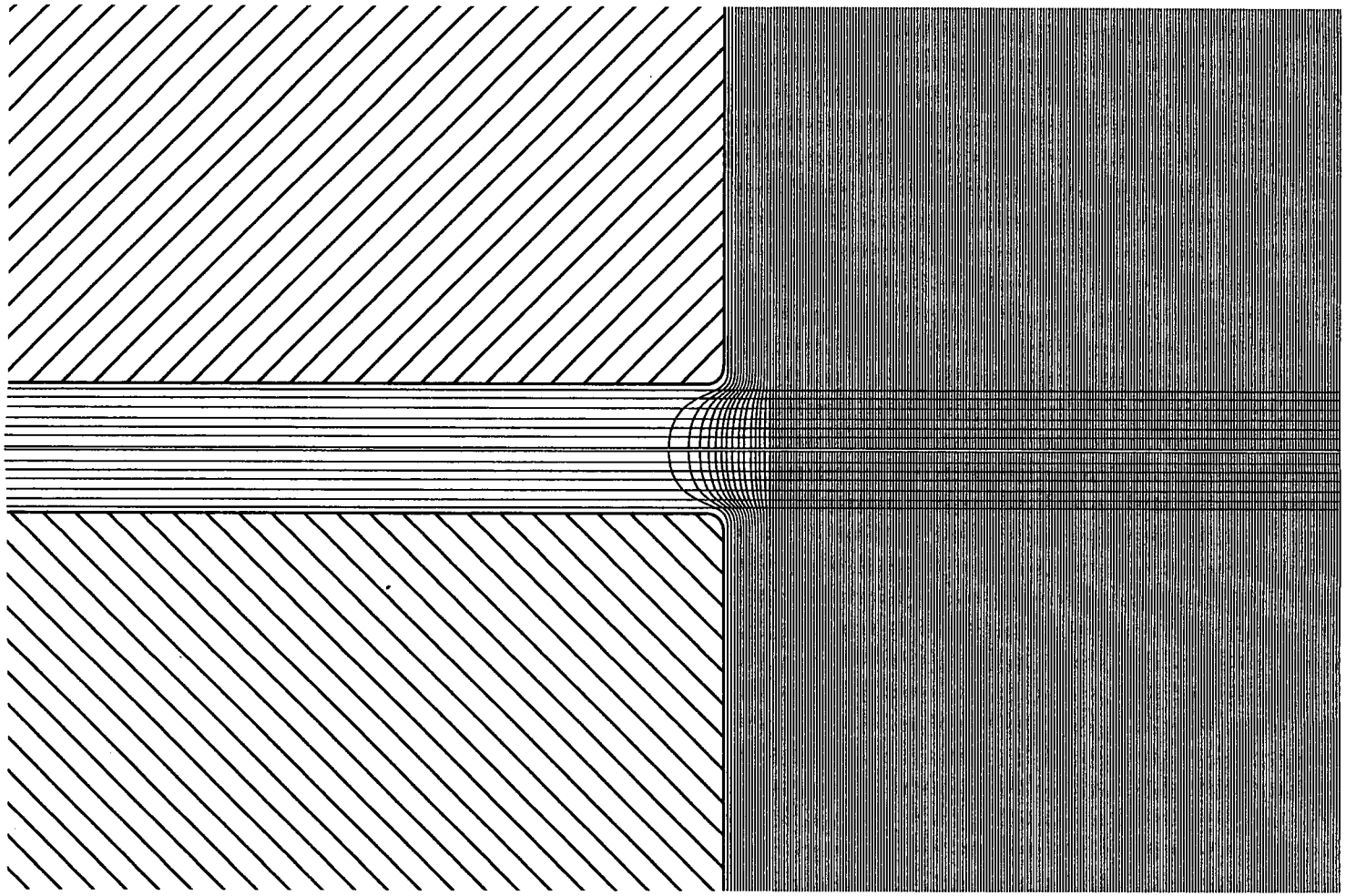


FIG. 12

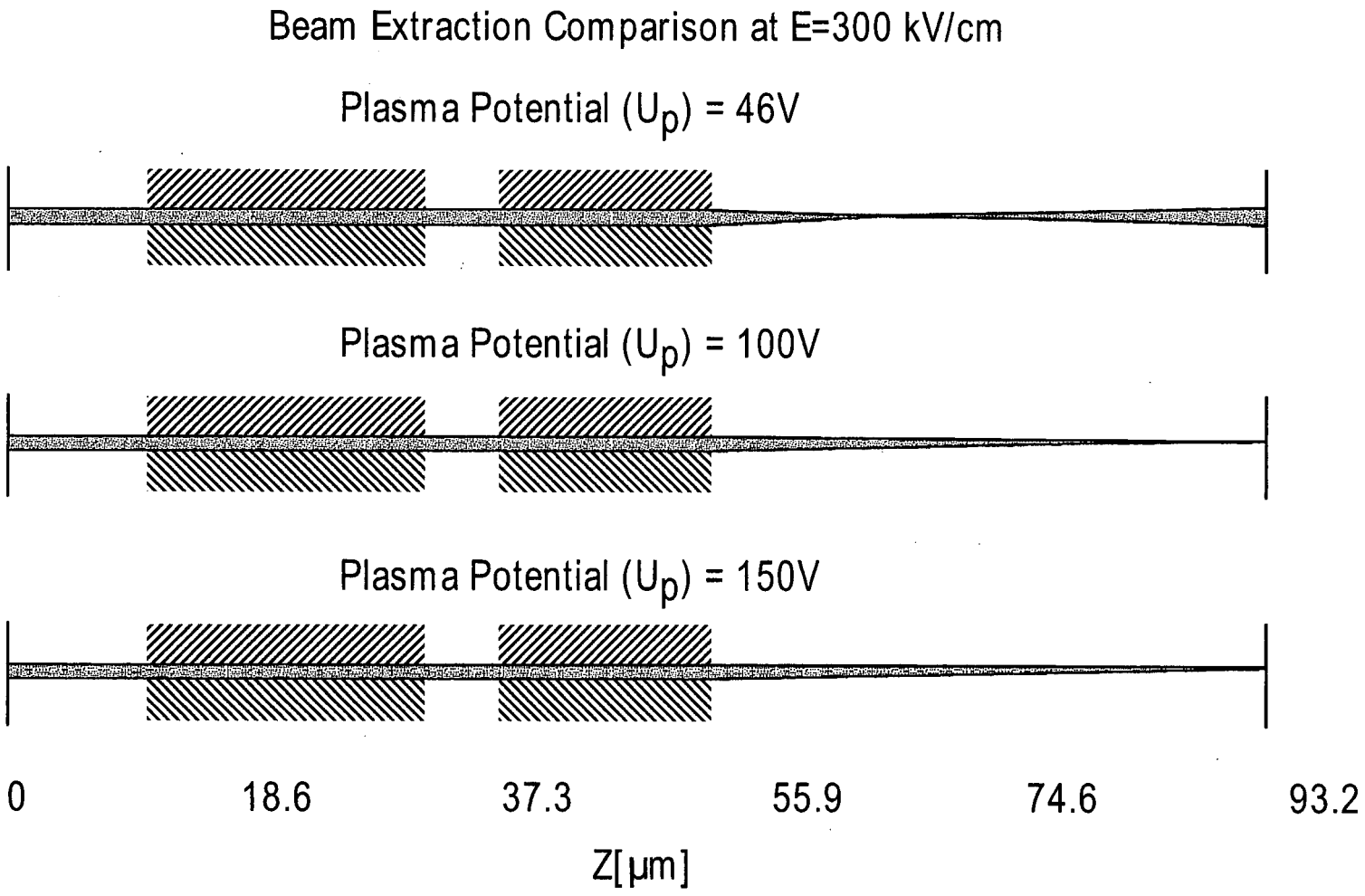

Beam Extraction Comparison at E=300 kV/cm
Plasma Potential (U_p) = 46V
Plasma Potential (U_p) = 100V
Plasma Potential (U_p) = 150V
0
18.6
37.3
55.9
74.6
93.2
Z[μm]

FIG. 13

Beam Extraction Comparison at E=300 kV/cm

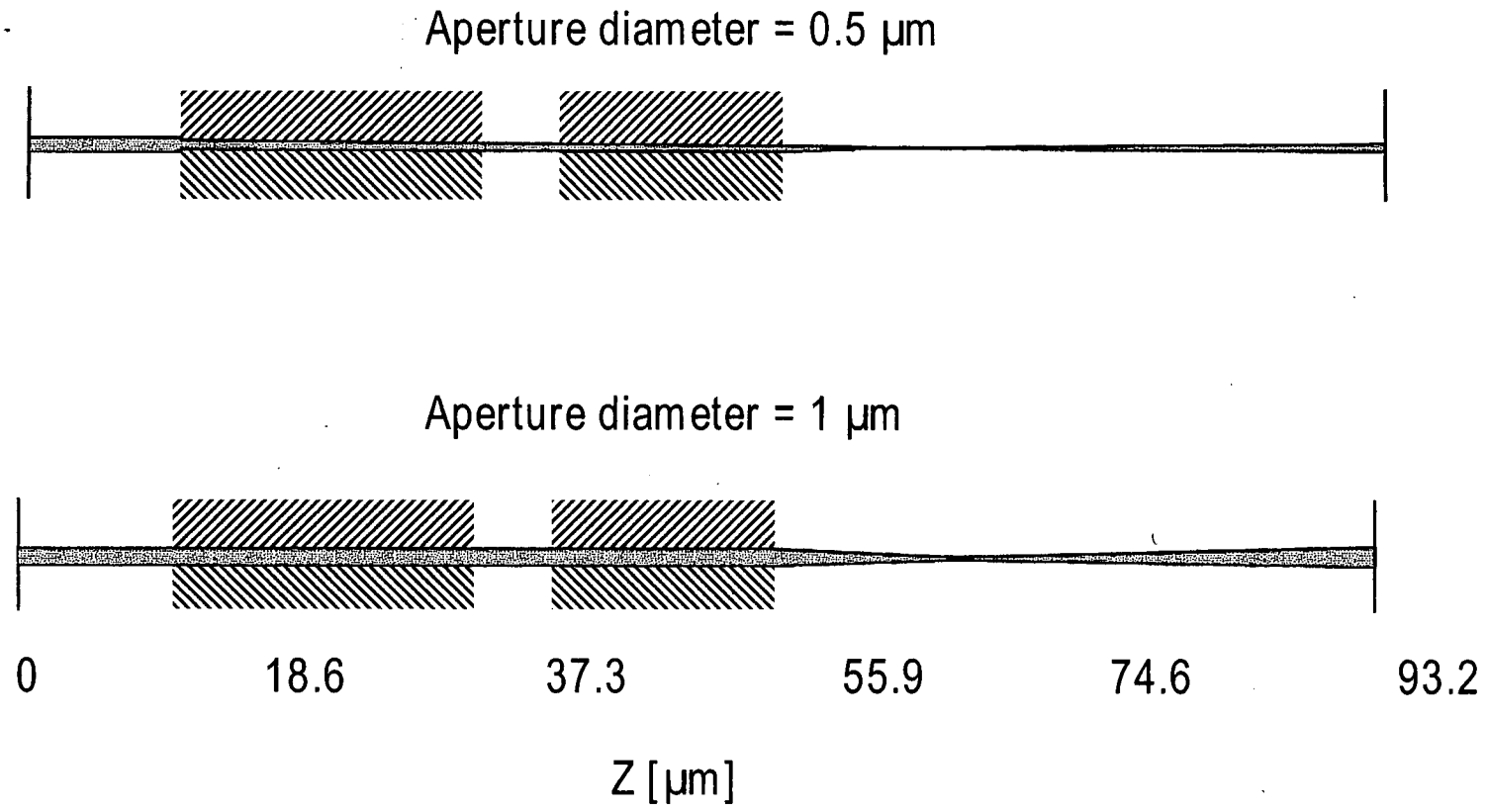


FIG. 14

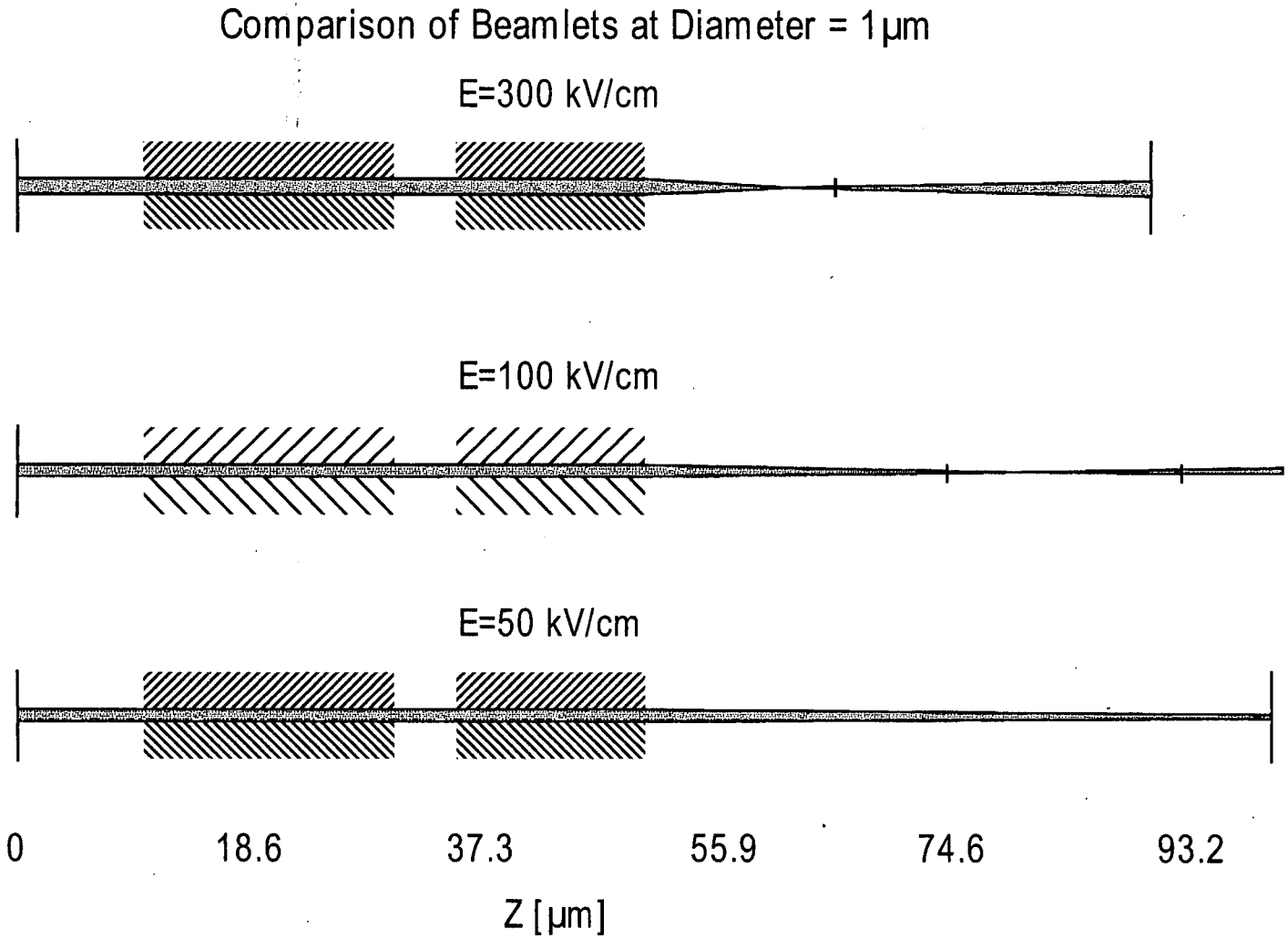
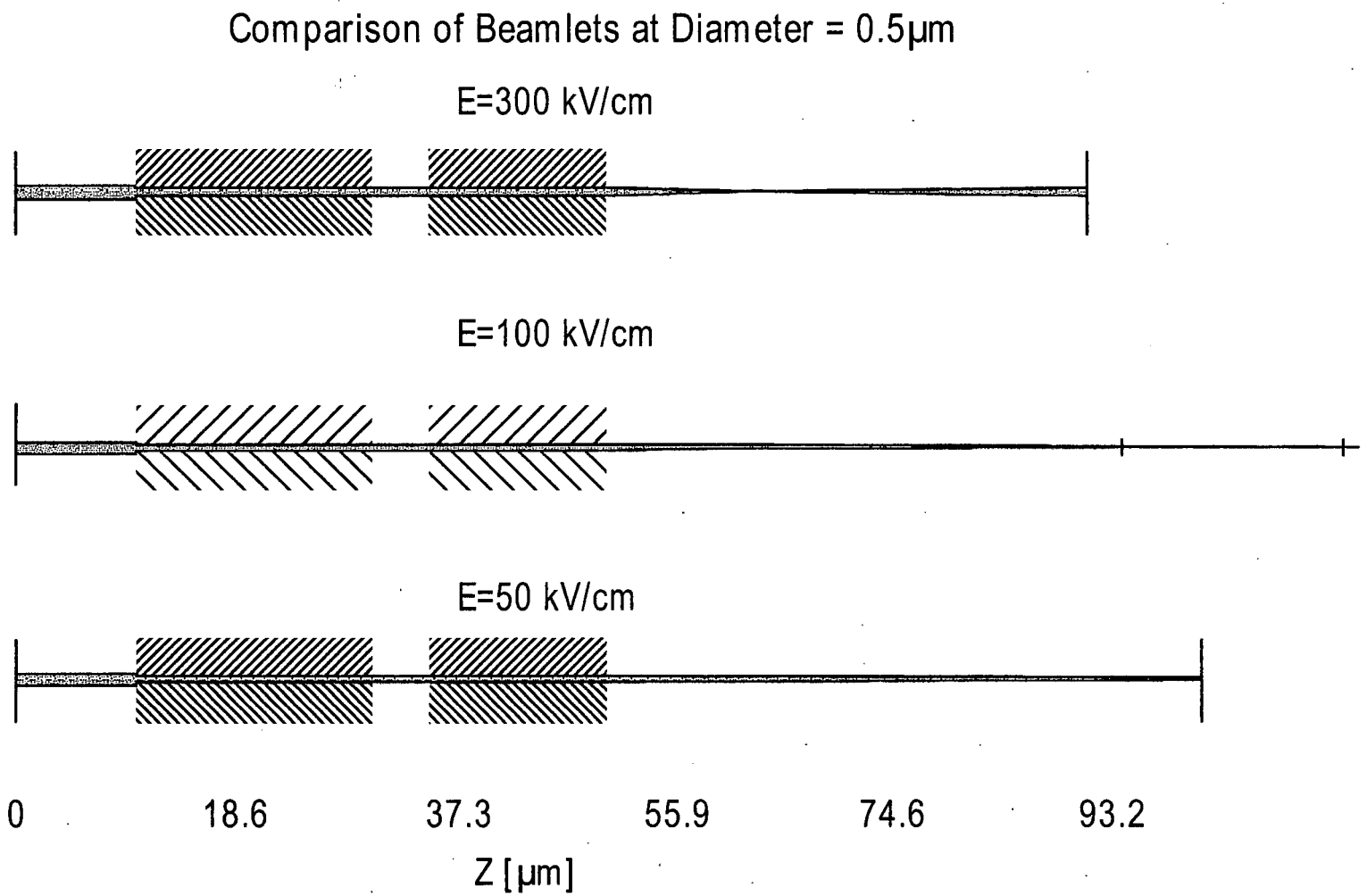

Comparison of Beamlets at Diameter = 1μm
E=300 kV/cm
E=100 kV/cm
E=50 kV/cm
0
18.6
37.3
55.9
74.6
93.2
Z [μm]

FIG. 15


Comparison of Beamlets at Diameter = 0.5µm
E=300 kV/cm
E=100 kV/cm
E=50 kV/cm
0
18.6
37.3
55.9
74.6
93.2
Z [µm]

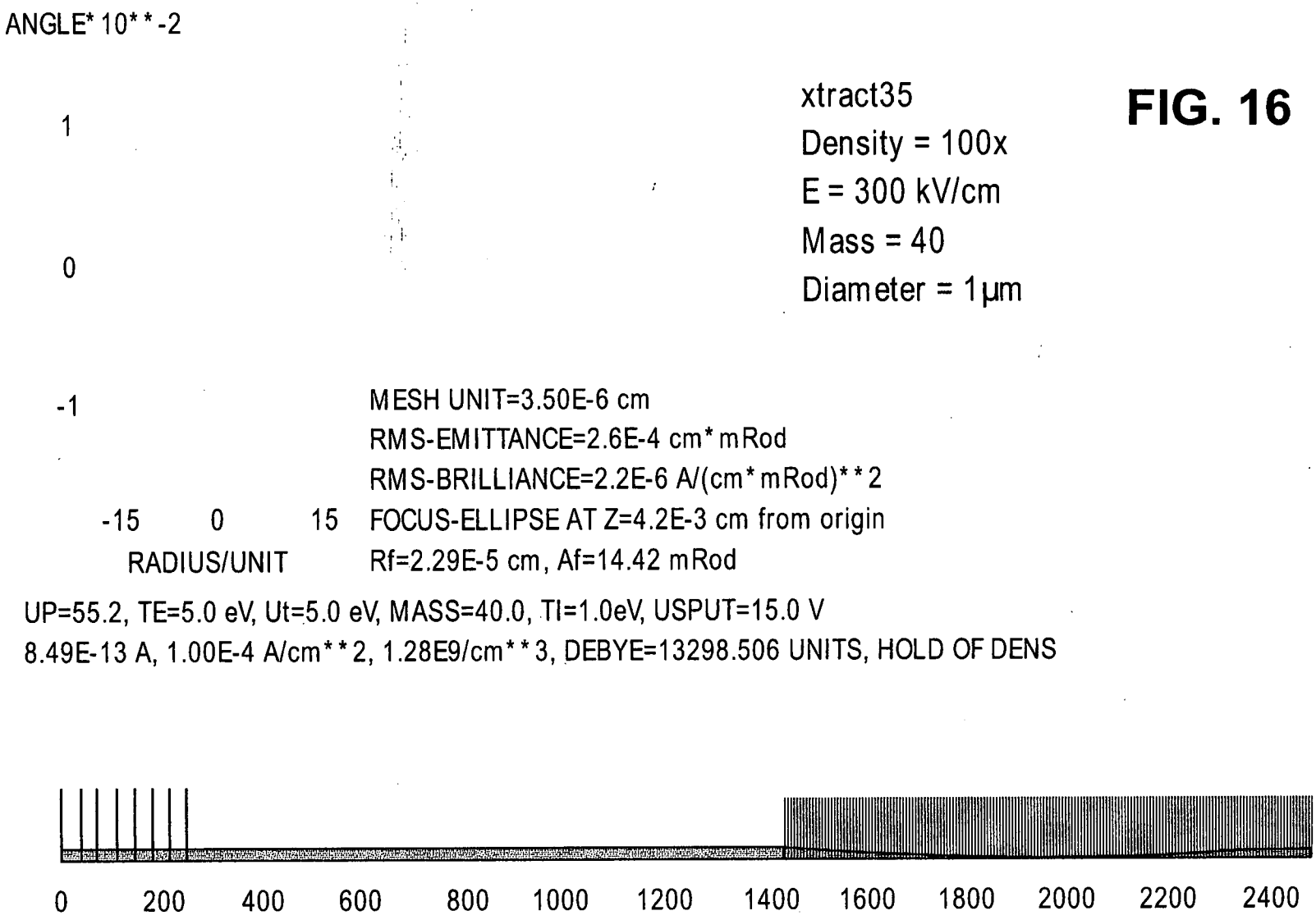

ANGLE* 10**-2
1
0
-1
-15
0
15
RADIUS/UNIT
xtract35
Density = 100x
E = 300 kV/cm
Mass = 40
Diameter = 1µm
MESH UNIT=3.50E-6 cm
RMS-EMITTANCE=2.6E-4 cm* mRod
RMS-BRILLIANCE=2.2E-6 A/(cm* mRod)**2
FOCUS-ELLIPSE AT Z=4.2E-3 cm from origin
Rf=2.29E-5 cm, Af=14.42 mRod
UP=55.2, TE=5.0 eV, Ut=5.0 eV, MASS=40.0, TI=1.0eV, USPUT=15.0 V
8.49E-13 A, 1.00E-4 A/cm**2, 1.28E9/cm**3, DEBYE=13298.506 UNITS, HOLD OF DENS
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400

FIG. 16

FIG. 17

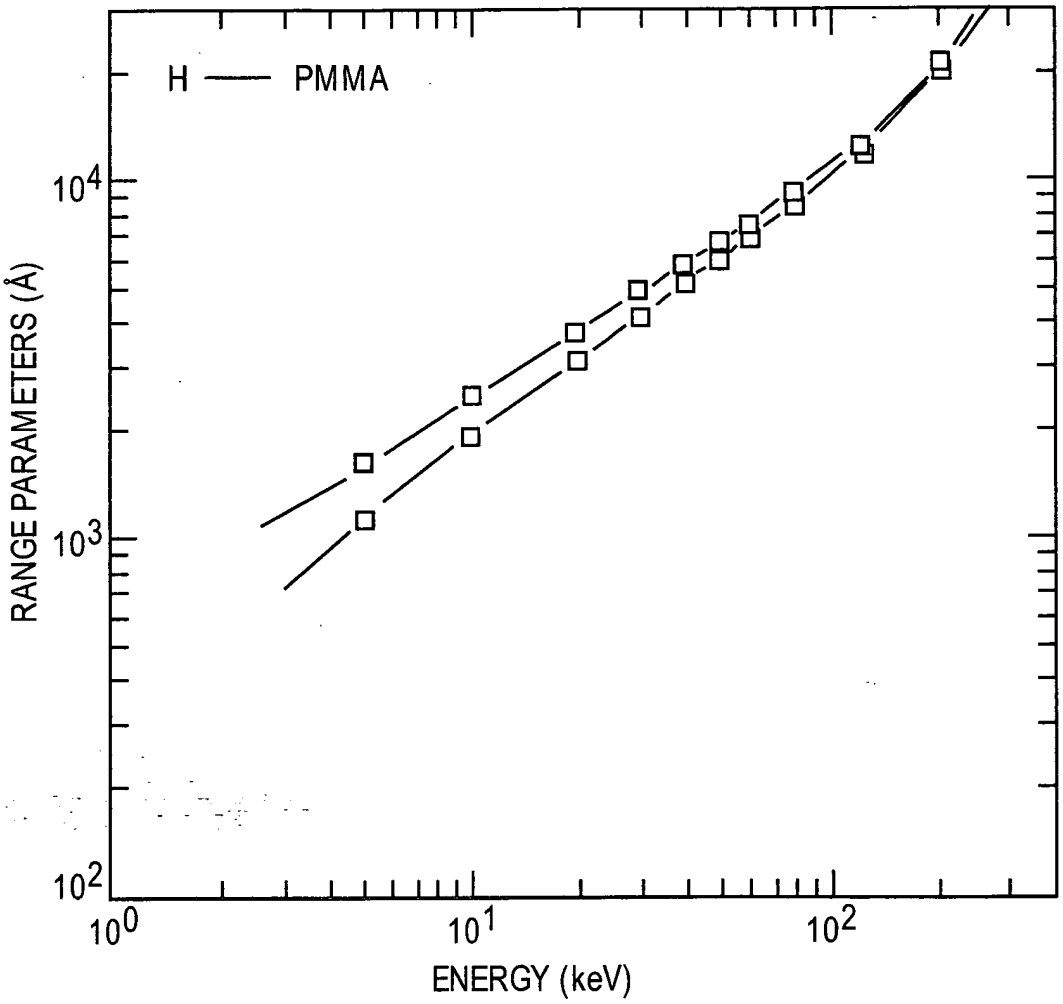


FIG. 18

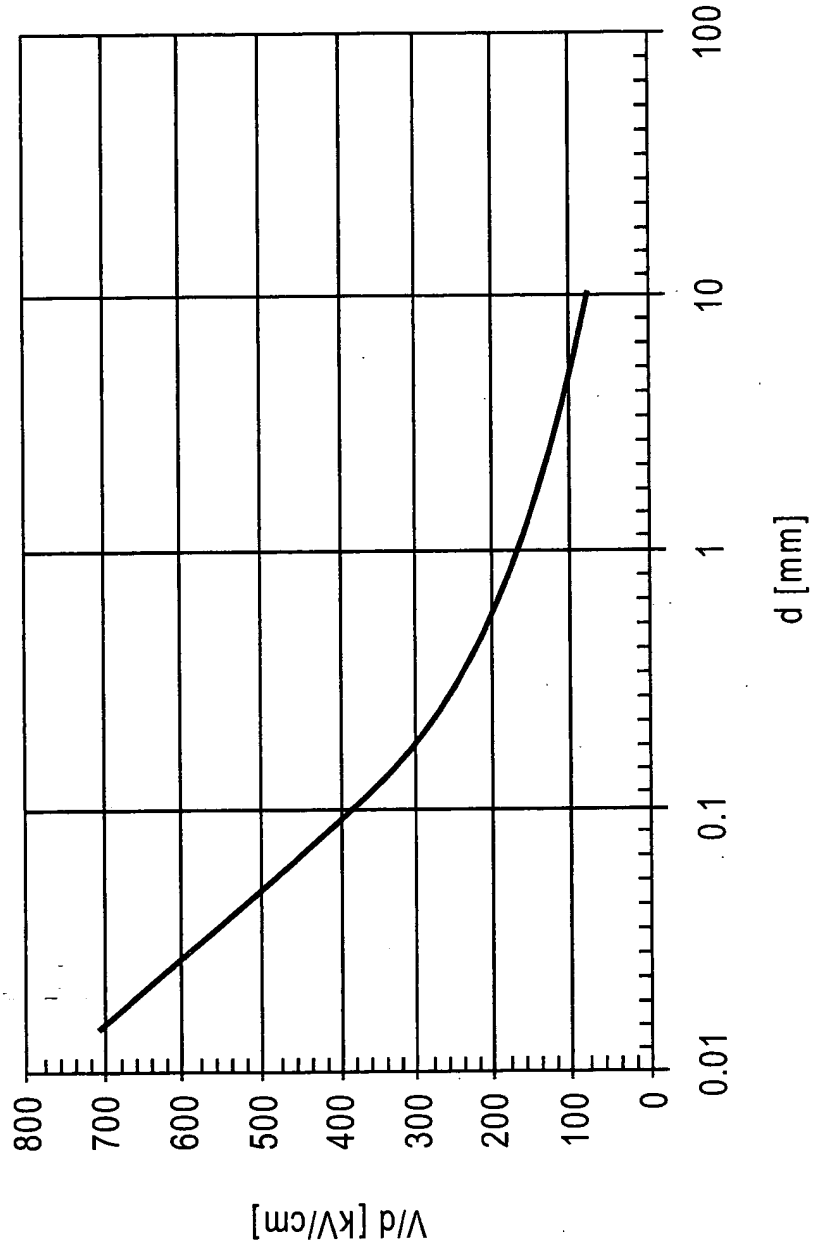


FIG. 19

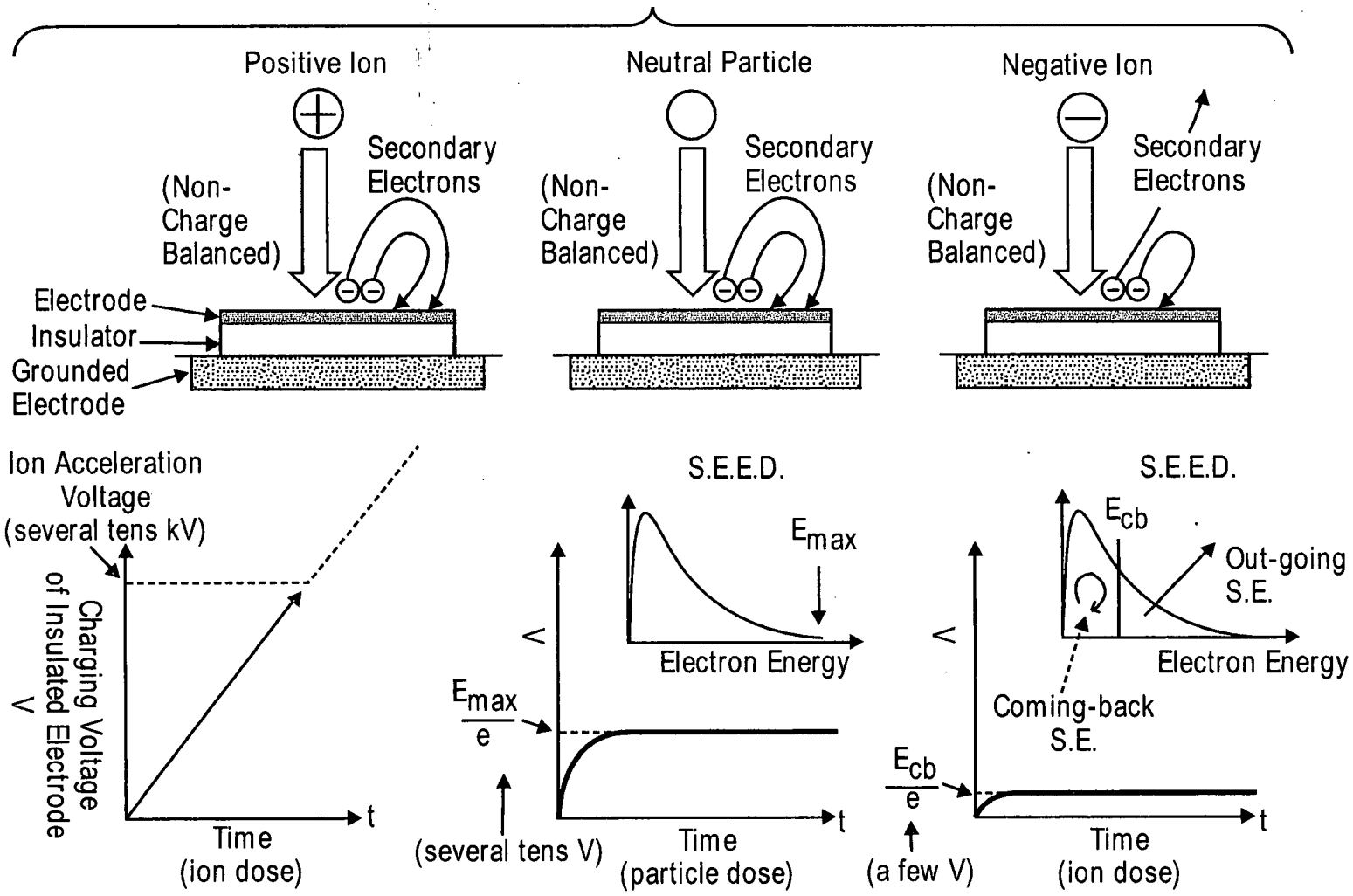
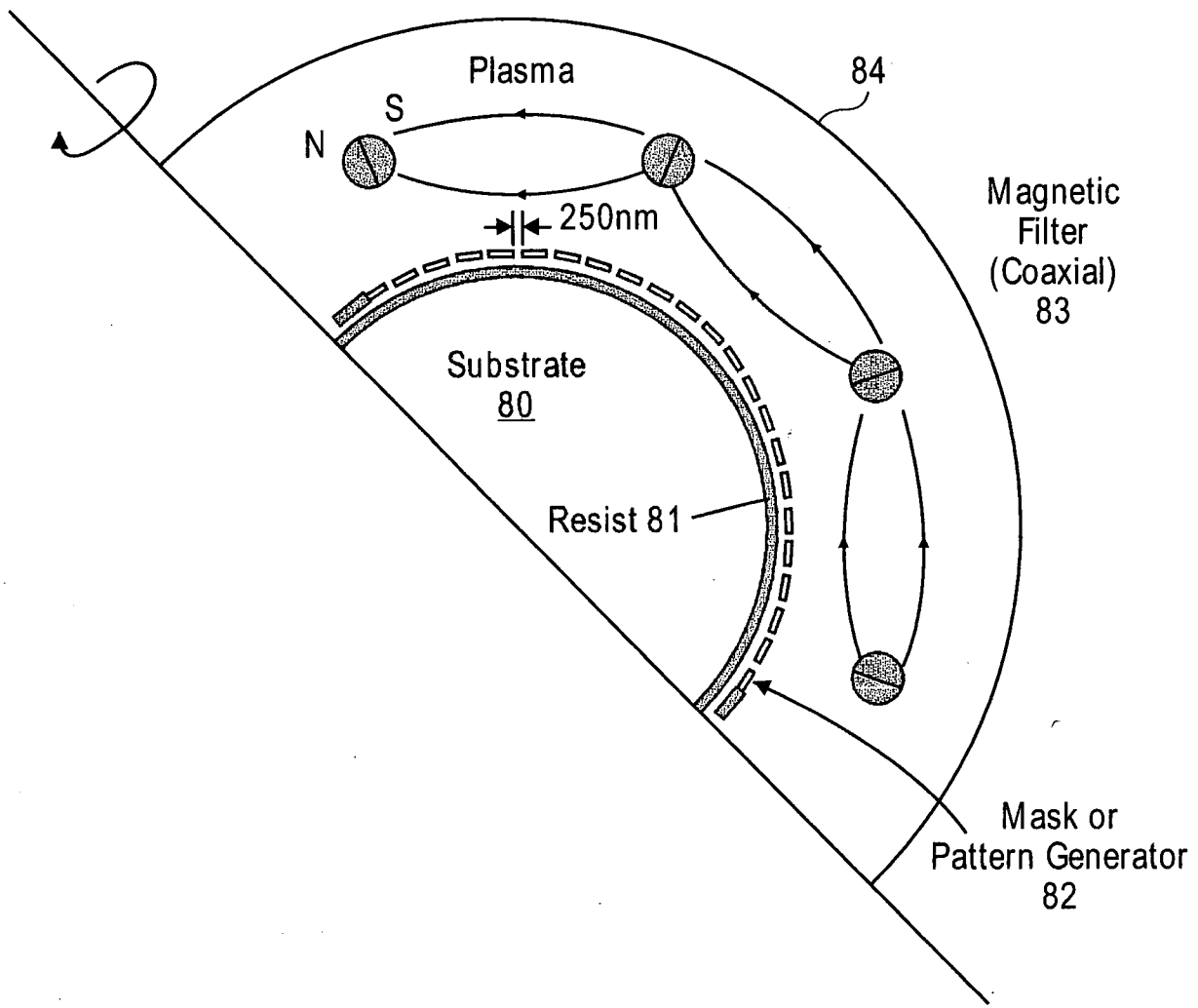

Positive Ion
Neutral Particle
Negative Ion
Secondary Electrons
(Non-Charge Balanced)
Electrode
Insulator
Grounded Electrode
Ion Acceleration Voltage (several tens kV)
Charging Voltage of Insulated Electrode V
Time (ion dose)
t
S.E.E.D.
Emax
Electron Energy
Emax / e
(several tens V)
Time (particle dose)
Ecb
Out-going S.E.
Coming-back S.E.
Ecb / e
(a few V)
Time (ion dose)

FIG. 20


Plasma
84
S
N
250nm
Magnetic
Filter
(Coaxial)
83
Substrate
80
Resist 81
Mask or
Pattern Generator
82